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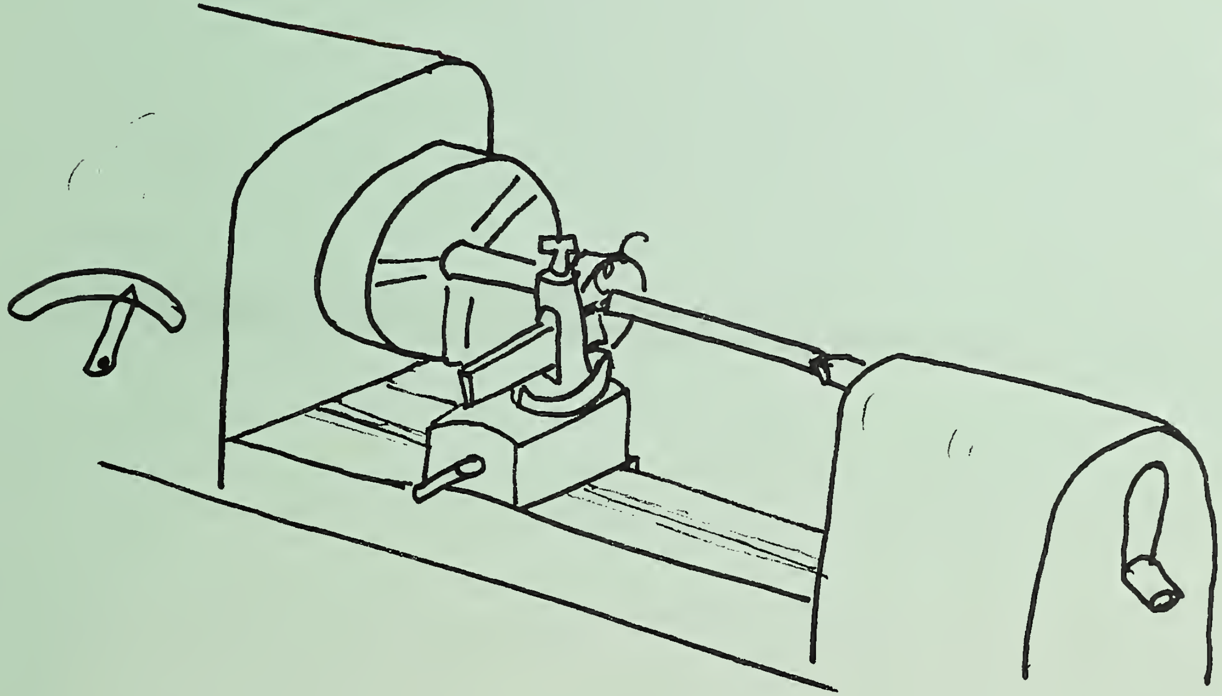
CONSTRUCTION AND FABRICATION

MACHINE SHOP



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ACKNOWLEDGMENTS

The Department of Education acknowledges with appreciation the contribution of the following Ad Hoc Committee members to the preparation of this Guide.

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NOTE: This Curriculum Guide is a service publication only. The Senior High School Program of Studies contains the official statement concerning Senior High School courses. The information contained in the Guide is prescriptive insofar as it duplicates that contained in the Program of Studies. There are in the Guide, however, as well as content, methods of developing the concepts, suggestions for the use of teaching aids and lists of additional reference books.

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I. INDUSTRIAL EDUCATION

Industrial Education is a program consisting of courses which provide a continuum of experiences, starting with exploratory activities in the junior high school and expanding in the high school to the development of skills related to career fields. This development of the student's skills is planned for through courses in Industrial Arts and Vocational Education culminating in on-the-job work experience, or entry into a job or post-high school institution for further education.

The program consists of courses ranging from those designed for an exploration of the technologies and trade areas to units of practical preparation for a career. In the process the courses develop the student's knowledge of himself, his talents and his skills.

The Industrial Education course "guides" provide the teacher with an outline of the topics, generalizations and concepts selected as most relevant for the physical and mental development of the students and the logical development of the subject area in accordance with the resources of the school in both teaching personnel and facilities.

The Guide leaves much scope for the teacher to develop content related to the topics, especially in writing behavioral objectives describing specific changes in student behavior anticipated from the learning tasks.

It is expected that each school district will develop a program of Industrial Education appropriate to the fulfilment of the needs of its student clientele.

II. OBJECTIVES

A. Industrial Education Objectives

The general objectives of Industrial Education complement the aims and objectives of the secondary school. The objectives of Industrial Education are:

1. To provide students with the curriculum content designed to develop fundamental tool and procedural skills which help prepare them to enter a family of occupations.

2. To provide students with courses that serve as vehicles which help them relate their academic knowledge to vocational competencies.

3. To provide students the opportunity to develop basic competencies, both academically and in work skills to enter either a job or a post-high school institution for further education.

4. To provide students with the environment whereby they may develop sound attitudes, acceptable work habits, and achieve a feeling of accomplishment.

B. Construction and Fabrication Career Field Objectives

The Construction and Fabrication career field should provide a student an opportunity to:

1. Gain an understanding of the career field.

2. Develop skills and knowledge necessary for job entry and/or articulation with post-secondary educational institutions.

3. Develop a standard of performance acceptable to craftsmen in the trade, government and industry.

4. Study labour organization and legislation regulating working conditions.

C. Major Area of Study Objectives

The specific objectives of the Machine Shop program are in harmony with the purposes of the Industrial Education Program and are as follows:

The Machine Shop courses shall provide students the opportunity to:

1. Learn and work in an environment that enables them to make a realistic assessment of themselves, their interests and aptitudes as they relate to Machine Shop.
2. Develop habits and attitudes acceptable to the trade concerning safety, working relationships, and efficient use of time and material.
3. Develop basic competencies in the use of tools, materials and processes that may be used to gain advanced placement in apprenticeship, technical institute programs or on the job.

III. EVALUATION

Evaluation of student growth should be based on stated behavioural changes and specific criteria understood by the students. Allowance should be made for both self and teacher evaluation and in some cases peer evaluation. Evaluation should be based on the three domains of learning as defined by an Alberta committee of Industrial Education teachers. Their categories are as follows:

a. Verbal and Written Communication
b. Personal Growth
c. Manipulative Skills.

The weighting given each of the three measures will depend on the nature of the behaviour being evaluated. For a more detailed treatment of evaluation see the Industrial Education Handbook.

IV. ORGANIZATION

A. Guide Organization

The course Guides are developed on the following pattern:

1. Topic: Each course is subdivided into a number of topics.

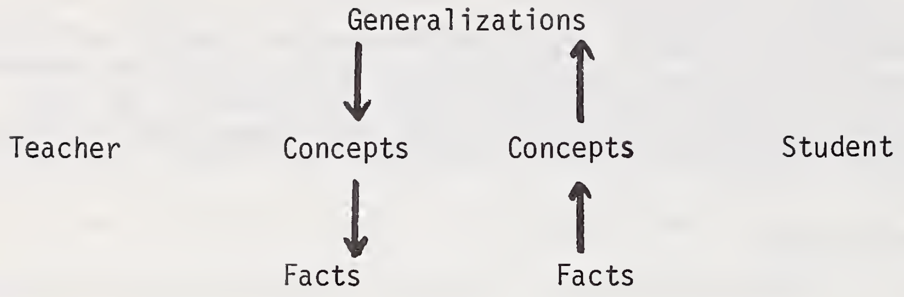
2. Generalization: The main generalization or "big" idea that students should learn follows each topic.

3. Concepts: The concepts divide the topic into the teaching components. They give more direction on specific areas that should be studied.

4. Behavioural Objectives: These describe specific changes in student behaviour which result from learning tasks he performs. The guide gives only a few sample behavioural objectives. It is the responsibility of the teacher to develop as many behavioural objectives as he can teach in the time available.

Facts are taken to be items of specific information, concepts are categories of information and generalizations express the relationship between concepts.

In planning a lesson, the teacher moves down this hierarchy whereas in learning, the student begins with facts and moves upward.



5. Suggested Activities: A few suggestions are made as to the types of activities that could be used to achieve the behavioural objectives.

6. Resource Materials: This column suggests where materials may be obtained.

B. Program Organization

1. Program Description

The Machine Shop modules give students the opportunity to learn the theory and skills necessary in the machinery trade. They will learn to identify and use hand and power tools to perform the major processes of shaping, forming and fastening metal products. Their projects can include activities ranging from cutting threads to making machine tools. In the process they will learn about the trade, job opportunities, business practices and enough skills to get a job, go into apprenticeship or enhance their avocational interests.

2. Program Major Organization

The major is divided into six-five credit modules and one module of 5-10 credits. Entry into the major is through Materials 10, General Technology 10 or Machine Shop 12. The modules are all sequential except 32A and B which may be taken at any time following the introductory modules.

32C is the last course in the 35-credit sequence and can be used to:

a. Provide greater depth to a module taken previously.

b. Take work in actual construction under a work experience plan whereby the Machine Shop teacher supervises the student on the job. The student must be under the supervision of a journeyman while on the job.

In addition to the modules set out in the major for Machine Shop a student may select modules designated as minors. These are normally the first level or introductory course of the area, e.g. Automotives would be Mechanics 12.

A student wishing to meet the requirements of the Apprenticeship Branch must complete all seven modules in the major area.

Some students, however, may take only a few modules in a major area as a supplement to their academic program or they may broaden their selection to other career fields. The scope of the Ikdustrial Education program allows the flexibility necessary for the program to be tailored to meet the interests and needs of the individual class or student.

The chart on page 7 gives a graphic description of the Machine Shop program. Each module is identified and the sequences are indicated by lines, e.g. After a student has completed one of Machine Shop 12 or Materials 10 or General Technology 10 he/she may advance to any module to which the solid line leads. In this case any of 22A, 32A or 32B. Module 32C requires that all modules before it be completed.

Once a student has enroled in a "22" or second level course he may also select modules from the minor fields.

Students may find some of the courses in the listed related field beneficial to their career program development.

C. Facility Organization

The organization of the physical facilities is in part determined by the original plan. There are however adjustments that can be made in the layout by the teacher to accommodate his/her style of teaching. The number of students in a class affects the way the lab or shop is organized. While most of the shops in Alberta are designed for 16 to 20 students a number of factors must be considered in the final assignment of class load. Theses factors include:

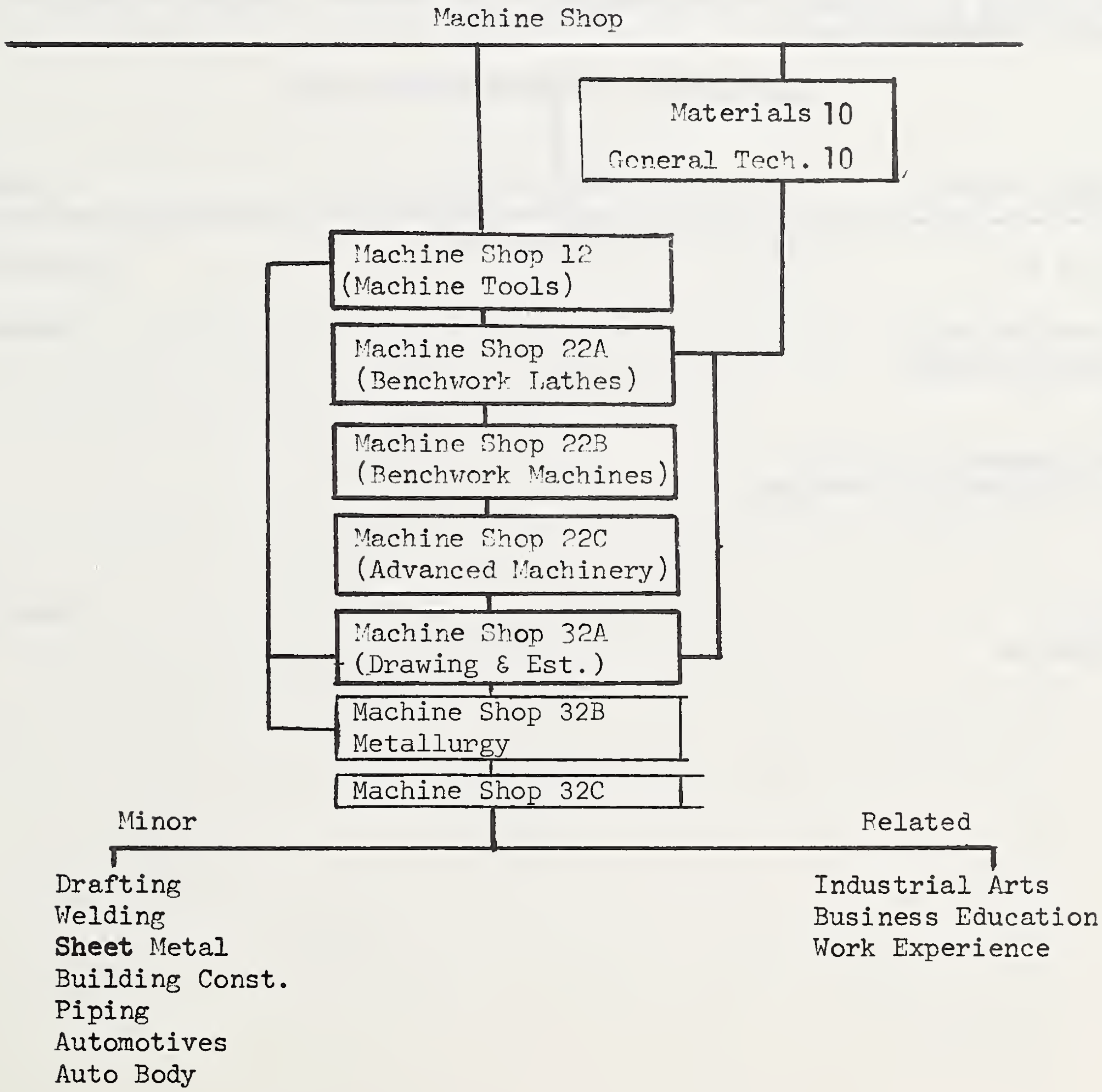
1. physical size of the shop or laboratory
2. type of student
3. amount of equipment

4. type of programming
5. type of course
6. training and experience of the teacher.

Safety of the students and their opportunity to obtain teacher contact are important considerations when class loads are determined.

CAREER FIELD

CONSTRUCTION AND FABRICATION



V. CAREER OPPORTUNITIES

Students taking all or most of the modules in the Machine Shop major may look forward to the following opportunities:

Machine Shop 12-22-32 (35 credits)

Post High School Studies

N.A.I.T. or S.A.I.T.

- Materials Testing and Metallurgy Technology
- Machinist
- Millwright
- Agriculture Mechanic
- Industrial Engineering Technology

UNIVERSITY

- Engineering
- Teacher Education

Career Entry

Apprenticeship:

Journeyman's - Machinist
Millwright
Foreman
Salesman

Teach: N.A.I.T., S.A.I.T.
High School
Community College

VI. MACHINE SHOP

1. Machine Shop 12

Introduction to Machinery

Machine Shop 12 is the first of a series of modules designed to make the student knowledgeable in the basic operation of machinery.

On completion of Machine Shop 12 or General Technology the student may advance to the "22" modules or Machine Shop 32A (Drawing and Estimating) or 32B (Metallurgy).

I. OBJECTIVES

The objectives of Machine Shop 12 are:

1. to give the students an understanding of the role of the machinist in industrial society.

2. to introduce the students to the safe use of tools and acceptable procedures basic to the machinists trade.

II. CONTENT SUMMARY

1. Safety
2. Measurement and layout
3. Tool processes
   -removial of material by mechanical means
   -power saw
   -lathe
   -shaper
   -drill press
   -grinder
4. Metal characteristics
   -identification
   -treatment
   -application

III. REFERENCES

*Hallet, Fred H. *Machine Shop Theory Practice*. (Revised edition) MacMillan Co. of Canada, Toronto.

Krar, S.F. and J.E. St. Amand. *Machine Shop Training*. McGraw-Hill Co. of Canada Ltd., Toronto.

* Most Important

IV. CONTENT

Generalizations, concepts and behavioural objectives are outlined on the following pages. Teachers are expected to develop additional behavioural objectives and activities to supplement the identified content and maintain relevancy.

Career Field: Construction and Fabrication

Topic I: SAFETY CONSCIOUSNESS

Major: Machine Shop

Generalization A: A knowledge and practice of safety is an essential consideration in all shop activities.

Course: Machine Shop 12 (Introduction to Machinery)

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Unsafe Act	2 hrs.	The student will:		
		a. list the consequences of unsafe acts in Machine Shop as they relate particularly to: (i.) lifting (ii.) eye safety (iii.) machine safety (iv.) safe clothing (v.) electrical wires.	Lectures, posters, movies, slides, guest speakers for unsafe acts.	
2. Unsafe Condition		a. discuss how to identify conditions which could lead to injuries on the job. b. list benefits available under the Workmen's Compensation Act and insurance plans.	Maintain tools and machines in proper working condition and make sure that protective equipment is always in place and/or immediately available. Analyze a machine operation for unsafe conditions.	

Notes:

Topic II: TOOL PROCESSES

Generalization B: Measurement and layout are essential in the manufacture and repair of most products.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Measuring	10 hrs.	The student will: a. identify and use various measuring tools and instruments: (i.) steel rule (ii.) protractor (iii.) calipers - inside, outside (iv.) micrometer caliper (v.) drill gauge.		
2. Layout		a. identify and use the following tools on a product requiring their use: (i.) scriber (ii.) layout dye or blue (iii.) prick and centre punches (iv.) steel rule (v.) dividers (vi.) try square (vii.) template.	Manufacture product: sliding T bevel, drill angle, gauge.	

Notes:

Generalization C: Materials are shaped by removing, combining and forming using hand and power tools.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Removal by Mechanical Means (i.) Shearing - hand tools	111 hrs.	The student will: a. remove material safely using the following: (i.) scriber (ii.) hack saw (iii.) chisel (iv.) file (v.) tap (vi.) die (vii.) abrasive cloth		
power tools		b. remove material safely using the following: (i.) power saw (ii.) lathe - facing - turning - threading (dies) - taper turning - 3 and 4 jaw chucks - centres - other lathe operations (iii.) shaper - flat surfaces - inclined surfaces - contoured surfaces	Centre punch, round ball, 3 step shaft to specifications.	

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		(iv.) drill prep - centre drill - twist drill - countersink - counterbore - reamer - drill gauge	Drilling, etc. - drawing drill over flowering surface.	
		(v.) grinder - freehand grinding.	Sharpen tool bits, sharpen chisels.	
2. Combining		a. combine various materials by: (i) soldering (ii) using fasteners -threaded, bolts -non threaded - rivets		
3. Forming		a. form metal by: (i) bending (ii) peening (iii) etc.		

Notes:

Topic

Generalization D: Different metals have special characteristics suitable for specific applications.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Identification	2 hrs.	The student will: a. identify various metal by: (i.) color (ii.) density (iii.) magnetic properties (iv.) hardness (file test) (v.) spark test.		
2. Treatment		a. harden and temper a product machined from heat treatable steel (i.e. high carbon or special alloy).		
3. Application		a. describe the circumstances where steels of different hardness and strength are required.		

Notes:

VI. MACHINE SHOP

3. Machine Shop 22A

Machine Tools

INTRODUCTION

Machine Shop 22A follows the introductory course and prepares students to advance to 22B and 22C in that sequence. Students may also advance to 32A or 32B on completion of 22A.

I. OBJECTIVES

The objectives of Machine Shop 22A are:

1. to provide the opportunity for students to study the trade of machinist.
2. to provide the opportunity for students to develop safe working habits and basic tool skills found in the trade of the machinist.
3. to provide the opportunity for students to gain experience in metal removal using mechanical means.

II. CONTENT SUMMARY

1. Career choices
   -occupations
   -opportunities
2. Measurement and layout
3. Safety
4. Tool Processes
   -removal of materials by hand and power tools

III. REFERENCES

McCarthy-Smith. *Machine Tool Technology*. 1968 McKnight and McKnight Publishers.
Feirer. *Machine Tool Metal Working*. 1973 McGraw-Hill Publishers.
John R. Walker. *Machining Fundamentals*. Goodheart-Wilcox Publishers.

IV. CONTENT

Generalizations, concepts and behavioural objectives are outlined on the following pages. Teachers are expected to develop additional behavioural objectives and activities to supplement the identified content and maintain relevancy.

Career Field: Construction and Fabrication

Topic I: CAREER CHOICES

Major: Machine Shop

Generalization A. There are many occupations within and related to the career field of construction and fabrication.

Course: Machine Shop 22A (Benchwork, Lathe)

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Career Field - Occupations	5 hrs.	The student will: a. list the various occupations available in the machine shop field and describe entry requirements to them. b. list courses available at technical schools and describe entrance requirements to them.	Guest speakers, field trips, videotapes, films, and slides.	
2. Related Occupations		a. list various occupations related to machine shop work and describe entry requirements to them. b. list related courses available at technical schools and describe entrance requirements to them.		
3. Employment Opportunities		a. describe the employment opportunities in machine shop and all of the related trades which require machine shop knowledge.		

Notes:

Generalization B: Measurement and layout are essential in the manufacture and repair of most products.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Measuring	5 hrs.	The student will:		
		a. identify and use various types of measuring tools and instruments used in machine shops and related trade areas: (i.) steel ruler (ii.) dividers (iii.) calipers (iv.) squares (v.) combination set (vi.) vernier calipers (vii.) micrometers (viii.) inside micrometers (ix.) indicating instruments (x.) blocks and gauges, etc.	Movies, hand outs and demonstrations.	
3. Layout	3 hrs.	a. layout projects on metal.	Projects or products.	

Notes:

Generalization C: A knowledge and practice of safety is an essential consideration in all shop activities.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Unsafe Act		The student will: a. list the consequences of unsafe acts in machine shop as they relate particularly to: (i.) lifting (ii.) eye safety (iii.) machine safety (iv.) safe clothing (v.) electrical wires.	Lectures, posters, movies, slides, guest speaker for unsafe acts.	
2. Unsafe Condition		a. discuss how to identify conditions which could lead to injuries on the job. b. list benefits available under the Workmen's Compensation Act.	Maintain tools and machines in proper working condition and make sure that protective equipment is always in place and/or immediately available. Analyze a machine operation for unsafe conditions.	

Notes:

Generalization D: Materials are shaped by removing, combining and forming, using hand and power tools.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Removal by Mechanical Means (i.) Shearing - hand tools	30 hrs.	The student will: a. remove material safely using the following: (i.) scribers (ii.) hack saws (iii.) chisels (iv.) punches (v.) files (vi.) reamers (vii.) taps (viii.) dies (ix.) honing, lapping and polishing (x.) other hand tools that might be used in machine shops.		
power tools	60 hrs.	b. remove metal safely using the following: (i.) lathe - sizing - threading - knurling - tapering - boring - other lathe operations	Projects.	

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
	15 hrs.	(ii.) grinders - choose the proper grind stones - grind and sharpen shop tools such as: drills lathe cutters milling cutters (optional) reamers, etc. (optional) - surface grind metal projects (optional)	Projects.	
		(iii.) drill press - choose proper drill - use proper cutting - fluids and coolants.	Projects.	

Notes:

VI. MACHINE SHOP

3. Machine Shop 22B

Benchwork, Machines

INTRODUCTION

Machine Shop 22B follows Machine Shop 22A and prepares the student to advance to 22C. The student may also proceed to 32A and/or 32B after completing 22B.

I. OBJECTIVE

The objective of Machine Shop 22B is:

-to provide the opportunity for students to gain experience in metal removal using mechanical and thermal means.

II. CONTENT SUMMARY

1. Material shaping
   -shearing tools
   -hack saws
   -chisels
   -files
   -taps and dies
   -reamers
   power tools
   -lathe
   -milling machine
   -shaper
2. Thermal Removal
   -use of oxy-acetyline torch

III. REFERENCES

McCarthy-Smith. *Machine Tool Technology*. 1968. McKnight and McKnight Publishers.
Feirer. *Machine Tool Metal Working*. 1973. McGraw-Hill Publishers.
John R. Walker. *Machining Fundamentals*. Goodheart-Wilcox Publishers.

IV. CONTENT

Generalizations, conepts and behavioural objectives are outlined on the following pages. Teachers are expected to develop additional behavioural objectives and activities to supplement the identified content and maintain relevancy.

Career Field: Construction and Fabrication

Topic I: TOOL PROCESSES

Major: Machine Shop

Generalization A: Materials are shaped by removing, combining and forming, using hand and power tools.

Course: Machine Shop 22B
(Benchwork, Machines)

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Removal by Mechanical Means (i.) Shearing - hand tools	10 hrs.	The student will: a. remove material safely using the following: (i.) hack saws (ii.) chisels (iii.) files (iv.) drills (v.) taps and dies (vi.) reamers (vii.) scribers (viii.) abrasives.	Lectures, films, demonstrations.	
power tools	50 hrs.	b. remove metal safely using: (i.) lathes - sizing - threading - knurling - tapering - boring - any other appropriate operations on the lathe using:	Projects.	

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		- face plate - steady rests - mandrels and collets		
	56 hrs.	(ii.) milling machines - types - cutting oils and coolants - methods of holding work - operations: - milling horizontal surfaces - milling vertical surfaces - milling angular surfaces - milling contours - end milling - milling slots and keyways	Projects.	
	10 hrs.	(iii.) shaper - types - methods of holding work - operations: - shaping horizontal surfaces - shaping vertical surfaces	Projects.	

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		- shaping angular surfaces - shaping keyways.		
2. Thermal Removal*	5 hrs.	a. using an oxy-acetylene torch, safely: (i.) cut metal (ii.) heat treat metals.	Projects.	

Notes: * If this equipment isn't available in the Machine Shop, the student can observe or do this in the Welding Shop or read it in texts.

VI. MACHINE SHOP

4. Machine Shop 22C

Advanced Machinery

INTRODUCTION

Machine Shop 22C follows Machine Shop 22B, Benchwork and Machines. From this module students may proceed to either Machine Shop 32A, Drawing and Estimating, or 32B Metallurgy.

I. OBJECTIVE

The objective of Machine Shop 22C is:

to introduce the student to the techniques and knowledge necessary in the production of machines with emphasis on mating and moving parts.

II. CONTENT SUMMARY

1. Advanced machinery
    - -mating parts
    - -fit
    - -classification
    - -assembly
    - -precision measuring
    - -shop calculations
    - -threads
    - -tapers
    - -pulleys and gears

2. Machine operations
    - -cutting threads
    - -tapers
    - -keyways
    - -spline cutting

3. Heat treating

III. REFERECES

Oberg, E. and F. D. Jones. *Machinery's Handbook*. (17th edition) The Industrial Press, 93 Worth Street, New York, New York.

Porter, H. W.; Lascoe, O. D. and Nelson, C.A. *Machine Shop Operations and Setups*. American Technical Society, Chicago, Illinois, 60637.

Feirer John; *Machine Tool Metal Working.* McGraw-Hill Book Company.

Fred Nicholson Henry Ford Trade School. *Shop Theory.* Webster Division, McGraw-Hill Book Company.

IV. CONTENT

Generalizations, concepts and behavioural objectives are outlined on the following pages. Teachers are expected to develop addtional behavioural objectives and activities to supplement the identified content and maintain relevancy.

Topic I: ADVANCED MACHINERY

Major: Machine Shop

Generalization A. Complex machines depend on functioning mating parts which must be machined to precise measurement.

Course: Machine Shop 22C
(Advanced Machinery)

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Mating Parts		The student will:		
(i.) Types of fit		a. describe the function of mating parts.	Machine projects requiring running fits.	
		b. define clearance fits, interference fits, clearance and tolerance.		
(ii.) Classification of cylindrical fits (A.S.A.)		c. list and describe the application of the various classes of cylindrical fits.		
(iii.) Assembly		d. assemble mating parts from drawings requiring the use of: (i.) layout tools (ii.) drills (iii.) countersinks (iv.) reamers (v.) rivetting (vi.) filing (vii.) threaded fasteners (viii.) tapers.	10" gear puller, top wrench or stock.	

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
2. Precision Measuring		a. use the following tools on various projects: (i.) dial test indicator (ii.) vernier height gauge (iii.) vernier protractor (iv.) combination square (v.) snap gauge (vi.) ring gauge (vii.) plug gauge.		
3. Shop Calculations				
(i.) Threads		a. identify parts of threads.		
		b. calculate tapping drill size.		
		c. calculate lathe thread cutting data.		
(ii.) Tapers		d. describe function of common tapers.		
		e. perform necessary calculations for turning tapers.		
(iii.) Pulleys and gears		f. calculate pulley and gear ratios.		
		g. identify parts of gear.		

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		h. design two gears that will run as a train.		
4. Machine Operations		a. perform the following machine operations: (i.) external right and left hand threads on lathe (ii.) internal right and left hand threads on lathe (iii.) common tapers on lathe (iv.) gear blanks on lathe (v.) keyways, internal and external on shaper (vi.) external keyways on milling machine (vii.) gear cutting on milling machine (viii.) spline cutting on milling machine (ix.) other milling machine operations (x.) set up and sharpen milling machine cutters.	Ball bearing grinder, arbour, double lathe centres.	
5. Heat Treating		a. define and describe the following heat treating processes: (i.) hardening (ii.) tempering (iii.) normalizing		

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		(iv.) annealing (v.) case hardening. b. using a hardness tester, determine the hardness of various materials. c. case harden a product machined from mild steel. d. harden and temper a product made from a hardenable steel, (i.e. s.p.s. 245).		

Notes:

VI. MACHINE SHOP

5. Machine Shop 32A

Blueprint Reading and Estimating

INTRODUCTION

The content of Machine Shop 32A consists of blueprint reading and estimating. It is a module that should be taken concurrently with another machine shop module.

I. OBJECTIVE

The objective of Machine Shop 32A is:

to introduce students to the use of graphic communications as applied in machine shops.

II. CONTENT SUMMARY

1. Graphic language
   - -types of drawings
2. Instrument drawing
   - -drafting tool use
   - -make drawings
3. Lettering
4. Shape description
   - -perspective
   - -orthographic
   - -oblique
   - -sectional views
5. Size description
6. Thread description
   - -conventional
   - -specifications
7. Freehand sketching
   - -isometric
   - -oblique
   - -orthographic

III. REFERENCES

Jensen. *Engineering, Drawing and Design.*

IV. CONTENT

Generalizations, concepts and behavioural objectives are outlined on the following pages. Teachers are expected to develop additional behavioural objectives and activities to supplement the identified content and maintain relevancy.

Topic I: INTRODUCTION

Major: Machine Shop

Generalization A: Drafting is the fundamental graphic language used to express ideas of a technical or practical nature.

Course: Machine Shop 32A (Blueprint Reading & Estimating)

oncept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
. Graphic Language		The student will: a. explain what is meant by "graphic language". b. explain the difference between word language and graphic language. c. explain the difference between artistic drawing and technical drawing. d. describe the usefulness of technical drawing. e. list occupations where technical drawing may be used. f. state the advantage of becoming proficient in the use of this "language".		

otes:

Topic II. INSTRUMENT DRAWING

Generalization B: Accurate, neat drawings can be made using special drafting tools.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Drafting Tool Use		The student will: a. demonstrate the correct use of: (i.) T square - horizontal lines (ii.) 30° - 60° triangle - vertical and angular lines (iii.) 45° triangle - vertical and angular lines (iv.) combination of both for angles having multiples of 15° and drawing parallel lines	Instrument drawings requiring use of thick, thin, broken and centre lines, but of uniformly heavy density.	
		(v.) scales - full scale, half scale, quarter scale. Architects scales.	Simple drawings requiring use of various scales.	
		(vi.) compass - (pencil) (vii.) dividers (viii.) eraser (ix.) erasing shield, by drawing accurate, clean, neat drawings of various problems.	Instrument drawings employing circles and tangent arcs.	

Notes: It is not intended that students should become very proficient with the use of drafting tools.

Generalization C: The appearance and usefulness of a drawing may depend on clear, legible lettering.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Legibility (i.) density (ii.) proportion (iii.) spacing (iv.) style		The student will: a. produce uniform legible, dense, sharp, vertical upper case gothic letters that are correctly proportioned and correctly spaced in words and sentences.	Lettering assignments.	

Notes: It is not expected that students will become highly proficient at lettering, however, they should be encouraged to continually improve their lettering performance.

Generalization D: The three projection methods used to represent objects on paper are perspective, orthographic and oblique.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		The student will:		
1. Perspective		a. given one point, two point and three point perspective drawings of an object, be able to identify each.		
2. Orthographic (i.) multiview		a. given machine parts or a pictorial representation of machine parts, correctly translate orthographic drawings using drafting instruments.	Missing line exercise. Missing view exercises. Simple machine drawings. Plan a shop considering stock routing, sequence of operations, kind and number of machines.	
		b. given machine parts, or orthographic representation of machine parts, correctly translate these to isometric drawings using drafting instruments.		
3. Oblique (i.) cavalier		a. given machine parts or orthographic representation of machine parts, correctly translate these to cavalier drawings.		
(ii.) cabinet		b. given machine parts or orthographic representations of machine parts, correctly translate these to cabinet drawings.		

Notes:

Topic V: SHAPE DESCRIPTION - SECTIONAL VIEWS

Generalization E: Interiors of objects, often too complicated to visualize by the use of hidden lines, are depicted by means of sectional views.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Sectional Views		The student will:		
(i.) cutting plane		a. explain the use of the cutting plane and cutting plane line, and crosshatch lines.		
(ii.) crosshatch lines		b. identify materials depicted by various crosshatch symbols.		
(iii.) full sections		c. draw full sections, given two or more views of the object.		
(iv.) half sections		d. draw half sections, given two or more views of the object.		
(v.) other sections		e. draw removed, revolved and broken out sections as specified by the teacher.		

Notes:

Topic VI: SIZE DESCRIPTION

Generalization F: Special techniques, symbols and rules are used when dimensioning drawings.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Dimensioning		The student will: a. given drawings of objects, select the required dimensions and notes and correctly place these on the drawings.		C.S.A. Mechanical Engineering Drawing Standards.

Notes:

Topic VII: THREADED FASTENER

Generalization G: Special techniques and symbols are used for threaded fasteners.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Conventional thread		The student will:		
(i.) thread representation		a. draw and label a national course thread, a square thread and an acme thread, using conventional representation.		
		b. draw square head bolts and nuts using conventional representation.		
		c. hex head bolts and nuts using conventional representation.		
(ii.) thread specification		d. correctly add thread notation and specification to above.		

Notes:

Topic VIII: FREEHAND SKETCHING PICTORIAL

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Isometric		The student will: a. given machine parts or orthographic multiview representations of machine parts, convert these to isometric sketches employing use of isometric axis, offset constructions, ellipses.		
2. Oblique (i.) cavalier (ii.) cabinet		b. given machine parts or orthographic multiview representations of machine parts, convert these to oblique sketches.		

Notes:

Topic IX: FREEHAND SKETCHING - ORTHOGRAPHIC MULTIVIEW

Generalization H: The ability to produce quick, accurate and clear sketches contributes greatly to the communication of technical ideas.

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Sketching Techniques		The student will:		
(i.) straight lines		a. given unlined paper, sketch horizontal, vertical and angular lines of correct weight and density.	Sketch simple objects in orthographic multiview.	
(ii.) circles and arcs		b. given unlined paper, sketch circles and arcs of circles having different radii.	Sketch objects employing circles, i.e. holes in their construction.	
(iii.) proportion		c. given unlined paper, sketch various machine parts in orthographic multiview estimating proportions accurately. Convert pictorial drawings into orthographic multiview sketches and dimension.		

Notes:

VI. MACHINE SHOP 32

6. Machine Shop 32B

Metallurgy

Metallurgy introduces students to the various types of metals, their characteristics, properties, alloys, production and methods of testing.

Students may advance to 32B directly from 12.

I. OBJECTIVES

The objective of Machine Shop 32B is:

to introduce students to metallurgy and its application to machines.

II. CONTENT SUMMARY

1. Ferrous and non-ferrous metals
   - -classification
     - -ferrous
     - -non-ferrous
   - -high temperature
   - -rare metals
2. Production of steel
3. Properties of metals
4. Testing and inspection of metals
5. Metal working processes
   - -removal
   - -joining.

III. REFERENCES

* *Materials Technology Lab. Manual.* Vega Enterprises Inc., R.R. #3, Box 3008, Decatur, Illinois.

McCarthy - Smith. *Machine Tool Technology.* McKnight and McKnight Publishers.

John R. Walker. *Machining Fundamentals.* Goodheart - Wilcox Publishers.

IV. CONTENT

Generalizations, concepts and behavioural objectives are outlined on the following pages. Teachers are expected to develop additional behavioural objectives and activities to supplement the identified content and maintain relevancy.

Topic I: FERROUS AND NON-FERROUS METALS

Major: Machine Shop

Generalization A: Metallurgy is the science and technology of metals including classification, production, properties, testing and processes of working them.

Course: Machine Shop 32B (Metallurgy)

oncept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
1. Classification	10 hrs.	The student will:		
(i.) ferrous		a. list the different types of ferrous metals and describe some of their characteristics: (i.) iron (ii.) iron alloys - grey cast - white cast - malleable cast (iii.) steel (iv.) steel alloys - nickel steels - chromium steels - manganese steels - molybdenum steels - tungsten steels - vanadium steels - highspeed steels - cobalt steels - carbon steels.	Lectures, films, charts, reference books, field trips and library research.	
(ii.) non-ferrous		b. list the different types of non-ferrous metals and describe some of their characteristics: (i.) aluminum	The student will observe, read about and machine these metals whenever possible.	

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		(ii.) copper (iii.) brass (iv.) bronze (v.) zinc (vi.) silver (vii.) gold (viii.) magnesium (ix.) lead (x.) tin (xi.) babbitt (xii.) pewter (xiii.) nickel.	Films, charts, field trips and library research.	
(iii.) high temperature		c. list the different types and determine some of the characteristics of: (i.) nickel (ii.) molybdenum (iii.) tantalum (iv.) tungsten.		
(iv.) rare metals		d. list the different types and describe some of the characteristics of: (i.) scandium (ii.) cerium (iii.) others.	Films, charts and library research.	

Notes:

Topic I: FERROUS AND NON-FERROUS METALS (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
2. Production		a. describe various ways that iron and steel are produced: (i.) blast furnace (ii.) other iron furnaces (iii.) cupola furnace (iv.) Bessemer converter (v.) open hearth furnace (vi.) crucible furnace (vii.) electric furnace (viii.) basic-oxygen process (ix.) other steel production methods.		
3. Properties	15 hrs.	a. list the different properties of materials and describe these properties as they relate to metals: (i.) properties - physical - chemical - mechanical - thermal - electric and magnetic - accoustical - optical. b. define the following terms: (i.) stiffness	Do appropriate exercises in the materials technology labs manual. Use the Vega Testing Machine if available.	

Notes:

Topic I: FERROUS AND NON-FERROUS METALS (Continued)

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		(ii.) elasticity (iii.) plasticity (iv.) ductility (v.) hardness (vi.) strengths - tensile - compression - shear - flexural - impact.		
4. Testing and Inspection of Metals	33 hrs.	a. describe the difference between testing and inspection and list the different types of each. He will then apply this knowledge to any testing or inspection that can be done in the shop.	Laboratory experiments in the *Vega Materials Technology Manual*. Experiments: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 17. Metcalf's experiment. Case hardening projects, heat treating projects, whenever possible, appropriate test of metals.	
		b. describe the following: (i.) inspection - X-ray - ultra sound - penetrant - magnetic particle (ii.) testing - impact	Machining of test projects on lathe.	

Notes:

Generalization

Concept and Sub-Concepts	Approx. Time	Behavioural Objectives	Activities or Jobs	Resources
		- fatigue - creep - compression - tensile - shear - flexural - spark - hardness testing.		
5. Metal Working Processes	35 hrs.	a. remove metal safely by shearing using the lathe.	Make test projects for the Vega Testing Machine. Any appropriate projects.	
	23 hrs.	b. join metals using: (i.) oxy-acetylene equipment (ii.) arc welders.	Weld coupons; test welds made.	

Notes:

VI. MACHINE SHOP

7. Machine Shop 32C

Open Module

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INTRODUCTION

This last module in the Machine Shop major is open to students who have completed 30 credits or six modules in the major.

The 125 hours of instruction time available in this module may be used to:

a. Provide greater depth to a module taken previously. Individual students, groups of students or the whole class may elect to study an area in depth. This could be more lathe work, metallurgy, other machining or any of the modules named in the Machine Shop sequence.

b. Engage in actual machining work supervised by the Machine Shop teacher as a work experience coordinator and a journeyman on the job.

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CURRICULUM GUIDE

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